

NASA SBIR/STTR Technologies

Advanced Carbothermal Electric (ACE) Reactor

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Contract No.: NNX11CB54C



Identification and Significance of Innovation

ORBITEC developed and tested an Advanced Carbothermal Electric (ACE) Reactor Engineering Unit to efficiently produce oxygen, iron and glass from simulated lunar regolith. The ACE reactor uses electrical energy heat the regolith within a thermally insulated environment. The ACE reactor concept has significant advantages over current carbothermal reactor approaches, including higher thermal energy efficiency and eliminating the need to keep optical surfaces clean during operation.

TRL Range at beginning & end of Phase 2 Contract: 4 → 5

Technical Objectives and Work Plan

The overall objective of the Phase 2 effort was to develop and test an ACE Reactor Engineering Unit.

- Task 1. Refine System Requirements
- Task 2. Evaluate Improved Heating Methods
- Task 3. Life Testing of the Crucible and Heating System
- Task 4. Develop the Preliminary Design
- Task 5. Perform Subsystem Testing
- Task 6. Develop the Detailed Design
- Task 7. Build the ACE Reactor Engineering Unit
- Task 8. Develop the Control System
- Task 9. Perform Check-Out Tests
- Task 10. Laboratory Testing
- Task 11. Delivery of the ACE Reactor Engineering Unit
- Task 12. Project Management and Reporting



ACE Reactor Engineering Unit

NASA and Non-NASA Applications

The ACE Reactor will efficiently produce oxygen, iron and glass from regolith to support human exploration of the Solar System. The unique ACE Reactor design requires 84% less thermal energy than the current state-of-the-art carbothermal reduction reactors to operate. This allows at least 12 times more regolith to be processed with the same amount of thermal energy. The ACE Reactor also separates the processed regolith into metallic iron and a silicate glass that can be formed into structural components. The innovative electric resistance heaters being developed for the ACE reactor could have a significant commercial market as the first high-temperature heating elements that can operate at temperatures >1400 C in oxidizing, reducing, or vacuum environments.

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NON-PROPRIETARY DATA